and Labyrinthodonts of the Northumberland coal-field." Now the illustration here referred to is not a restoration of the palate of *C. cristatus*, Agassiz, but of that of *C. tuberculatus*, nobis. Secondly, he states that we describe the upper surface of the tooth of *C. cristatus* as convex, whereas in reality we state that it is "somewhat hollowed or concave." Our paper noticed by Mr. Miall was published in the 'Nat. Hist. Trans. of Northumberland and Durham,' vol. iii. p. 61, the illustration referred to in vol. iv. pl. 14.

EXPLANATION OF PLATE XIX.

Fig. 1. Outside view of right mandible of *Ctenodus obliquus*, nat. size.
Fig. 2. Right mandible, seen from above: *a*, articular piece; *d*, dental plate; *s*, symphysis of jaw.
Fig. 3. Left pterygo-palatine bone, with dental plate attached, of *Ctenodus obliquus*, nat. size: *a*, anterior end; *pt*, pterygoid border; *p*, palatine border; *s*, symphysis; *sp*, rough surface for articulation with the sphenoid bone.
Fig. 4. Vomerine tooth of *Ctenodus*, nat. size: *a*, front, *b*, side, *c*, back view.

XXXIX.—*Notes on some Young Stages of* Umbellularia, *and on its Geographical Distribution.* By R. v. Willemoes-Suhm, Ph.D., Naturalist to the 'Challenger' Expedition.

[Plate XVIII. A.]

Since *Umbellularia* was rediscovered by the Swedish Expedition to Greenland, the attention of zoologists has been specially drawn to it by a paper, with excellent plates, by T. Lindahl*, who himself brought it down from the Arctic regions. Another note has been published by Prof. Kölliker† on specimens of *Umbellularia* which were brought up during H.M.S. 'Challenger's' cruise in the Atlantic, and sent to him for description by the hydrographer. Both authors were kind enough to send us their papers; and as in the mean time we got a good many more *Umbellulariæ*, and even young stages of them, I think a few notes on the geographical distribution of the genus as far as it is now known to us will be welcome to zoologists, as also will a few figures of the earliest stages which we brought up in the Antarctic Ocean.

* "Om Pennatulidslägtet *Umbellula*," Kongl. Svenska Akademiens Handlingar, Bandet xiii. No. 3, Febr. 10, 1874.

† 'Ueber den Bau und die systematische Stellung der Gattung *Umbellularia*,' Würzburg, 2. Mai, 1874.

Umbellularia Thomsonii, Köll., was found in the *Atlantic* three times :—

1. Between Cape St. Vincent and Madeira, in lat. 35° 20′ N., long. 134½° W., at a depth of 2125 fathoms. The specimen is the largest that has been found ; length, according to Kölliker, 89·5 centims.

2. 300 miles to the eastward of St. Paul's rocks, lat. 1° 47′ N., long. 24° 26′ W., at a depth of 1850 fathoms. This is the smaller specimen which was sent to Prof. Kölliker, who says it has a length of 27 centims.

3. On the coast of Brazil, off the mouth of the San Francisco river, lat. 10° 11′ S., long. 35° 22′ W., in 1600 fathoms. A half-grown specimen.

In the *Antarctic sea* we brought up five times different stages of an *Umbellularia* which is very much like the Atlantic species ; but whether it is the same or not could not be decided, as the specimens of the latter had already been sent to Europe. The Antarctic species was found in the following localities :—

1. Halfway between Prince Edward's and Crozet Islands, lat. 46° 46′ S., long. 45° 31′ E., at a depth of 1375 fathoms. A half-grown specimen.

2. 84 miles to the westward of Hog Island (Crozets), lat. 46° 16′ S., long. 48° 27′ E., at a depth of 1600 fathoms. A full-grown specimen of nearly the same size as the first one found in the Atlantic.

3. Near the ice-barrier, lat. 62° 26′ S., long. 95° 44′ E., at a depth of 1975 fathoms. Several very small and middle-sized specimens, some of which will be described hereafter.

4. On our way from the ice-barrier to the north, lat. 53° 55′ S., long. 108° 35′ E., at a depth of 1950 fathoms. Rather small specimens.

5. South of Australia, lat. 42° 42′ S., long. 34° 10′ E., at a depth of 2600 fathoms. Middle-sized specimens.

We also found an *Umbellularia* in the *Pacific*, at a depth of 2440 fathoms, to the south-west of the Louisiade archipelago, where two specimens were brought up, which very likely are different from all those which we got before, as the polyps appeared to be more flattened, wider, and shorter.

During our cruise through the Malayan archipelago none of these Pennatulids came up.

According to these data, *Umbellularia* was never found by the 'Challenger' in such comparatively shallow water as that in which it has been obtained off the coasts of Greenland. In the neighbourhood of the Antarctic islands it was often found in very deep, never in shallow water.

The following is a list of all the depths from which *Umbellularia* has been brought up:—

1. Off the coasts of Greenland: 236 fathoms (*Adrians*), 410 and 122 fathoms (*Lindahl*).

2. In the Atlantic: 1600, 1800, and 2150 fathoms.

3. In the Antarctic sea: 1375, 1600, 1975, 1950, and 2600 fathoms.

In the Pacific in 2440 fathoms.

The greatest depth at which this Expedition procured *Umbellularia* is accordingly 2600 fathoms, the least 1375 fathoms. It is usually associated with such decidedly deep-sea animals as *Ophioglypha*, *Brisinga*, *Pourtalesia*, Ananchytids, Munopsids, *Petalophthalmus*, *Gnathophausia*, *Macrurus*, &c.

After these remarks on its geographical distribution as far as it is known to us at the present moment, I shall proceed to give a few details on its young stages, which were found at station no. 3 in the Antarctic sea, and which show, better than the full-grown specimens of Lindahl and Kölliker, the very marked bilateral symmetry of the polypary and the order in which the polypes succeed each other.

Lindahl has given, on page 8 of his paper, an ideal sketch of what he thinks to have been the successive appearance of the polypes on the polypary. According to him, the oldest or terminal polyp (T in his and in my figures) remains during the first five stages at the top, above the others. Then only the lateral polypes (I. and II.) come forth, and two of them advance to the top, while the terminal one is removed towards the centre.

In the Greenland species of *Umbellularia* this may be perfectly correct, but in the Antarctic species, of which we actually got the young stages, the mode of growth is a little different. This will be confirmed by a glance at my figures. The smallest specimen (Pl. XVIII. A. fig. 1), having only a length of 41 millims., shows clearly that here also a terminal polype (T), which is 2 millims. longer than the lateral ones, has first made its appearance. The lateral ones have come out a little later, but both at the same time, not the right one earlier than the left, as is supposed in Lindahl's diagrammatic figures. The same stage is represented by a larger specimen (fig. 3), length 100 millims., in which the terminal polype is still the largest, but in which the lateral ones are already nearly of the same size. The reason why in this large specimen there are only three polypes, while a much smaller one now to be described has already four, is probably want of food.

The first change which takes place is the coming out of

another terminal polype, which is effected by the first polype (hitherto at the top) being removed a little towards one side; and we now get an arrangement (fig. 4) in which there is a polype close to the top on each side of the end of the rachis, or they both grow out at right angles from the latter; and the polypary now, as in fig. 2, presents a perfectly symmetrical arrangement, viz. two polypes on one side and two on the other.

The *end of the rachis* is clearly visible in fig. 1, which has been drawn from a specimen made transparent; and it is indicated by a knob in fig. 2. *Spicula* were not visible in fig. 1. *Zooids* are first to be seen on the ventral side of fig. 2, and so they are in fig. 3; in the largest of the specimens here figured they cover the ventral side of fig. 4 *a*, but leave free a middle line on the dorsal end of the same.

The mode of growth of the polypes in this Antarctic *Umbellularia* is therefore, so far as our specimens show, as follows:—

1. The terminal polype comes out (fig. 1).
2. The terminal polype grows, and two lateral ones come out (figs. 1 and 3).
3. The terminal polype loses its place by another one coming out, and is removed towards the side (figs. 2 and 4). There are now on each side a terminal and a lateral polype (according to Lindahl's nomenclature).
4. A fifth polype is coming out in the centre of the polypary (fig. 2 *b*, III.); and the rest of the polypes very likely come out below the first two lateral ones.

In the earliest stage there are neither spicula nor zooids; the latter, when they have come out, leave a line free on the dorsal side of the polypary.

H.M.S. 'Challenger,'
Manilla, January 1875.

EXPLANATION OF PLATE XVIII. A.

All the figures give the natural size of the polypes. In fig. 1 the rhachis has been put in as seen by a low magnifying-power. Letters the same in all the figures:—T = terminal polypes; I. and II. = lateral polypes; III. = third lateral or fifth polype; Z = zooids.

Figs. 1–4. Young stages of *Umbellularia* sp.?, found near the antarctic ice-barrier, lat. 62° 26′ S., long. 95° 44′ E., in a depth of 1975 fathoms.

Fig. 1. From the ventral side. Length 41 millims.

Fig. 2 *a*, from the ventral side; 2 *b*, from the dorsal side. Length 52 millims.; length of polypes 7–8½ millims.

Fig. 3. From the ventral side. Length 100 millims., of polypes 11 millims.

Fig. 4 *a*, from the ventral side; 4 *b*, from the dorsal side. Length 385 millims., of polypes 15 millims.